USE OF A GSR PARTICLE ANALYSIS PROGRAM ON AN ANALYTICAL SEM TO IDENTIFY SOURCES OF EMISSION OF AIRBORNE PARTICLES

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High concentrations of airborne particles, in particular PM_{10} (particulate matter <10 μ m), are associated with health and visibility degradation problems in urban areas. Source identification techniques based on bulk chemical analysis are not capable of distinguishing emissions from sources with similar chemical composition (e.g. mineral dust and flyash, and soil and roadside dust). We have used a scanning electron microscope to analyse individual particles collected on carbon tape, using an automated particle analysis program. This approach can provide a more detailed and accurate identification of sources of PM_{10} , but has been little used in Australia for airborne particulates.

Two sets of 15 min PM₁₀ samples were collected in March and April 2000 from two sites in Brisbane, one within a suburb and one next to an arterial road. The particles were collected directly onto double-sided carbon tapes with a cascade impactor attached to a high-volume PM10 sampler. The carbon tapes were analysed in a JEOL 840 SEM equipped with a Be-window energydispersive X-ray detector and Moran Scientific microanalysis system. An automated Gun Shot Residue (GSR) program was used together with backscattered electron imaging to characterise and analyse individual particulates. About 6,000 particles in total were analysed for each set of impactor samples. Due to limitations of useful pixel size, only particles larger than about 0.5 µm could be analysed. The size, shape and estimated elemental composition (from Na to Pb) of the particles were subjected to non-hierarchical cluster analysis and the characteristics of the clusters were related to their possible sources of emission.

Both samples resulted in similar particle clusters. The particles could be classified into three main categories: non-spherical (58% of the total number of analysed particles, shape factor >1.1), spherical (15%) and "carbonaceous" (27%, i.e. with unexplained % of elemental mass >75%). Non-spherical particles were mainly sea salt and soil particles, and a small amount of iron, lead and mineral dust. The spherical particles were mainly sea salt particles and flyash, and a small amount of iron, lead and secondary sulphate dust. The carbonaceous particles included carbon material mixed with secondary aerosols, roadside dust, sea salt or industrial dust. The arterial road sample also contained more roadside dust and less secondary aerosols than the suburb sample.

Current limitations with this method are the minimum particle size, difficulties in identifying and analysing light element particles, and uncertainties in the quantitative analyses.